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Generic green skills: maturity level of vocational education teachers and students in Indonesia

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ABSTRACT

Vocational education (VE) is one of the institutions that must answer environmental problems by providing green job skills to its students. However, VE in Indonesia still experience various obstacles in providing this provision, so the aim of this research aims to analyze the extent of the level of green skills (GS) in teachers and students in this country, which includes the dimensions of cognitive, interpersonal and intrapersonal competence as an illustration for developing a priority scale for improvement. In addition, examining the differences and correlations between dimensions and the contribution of dimensions to GS as a whole is an additional goal. The survey method was carried out using a generic GS questionnaire instrument in VE that have Adiwiyata status. Data were analyzed using three stages: descriptive analysis, ANOVA-post hoc Tukey test, and path analysis. As a result, students' GS still show a low category, while teachers get a high category. Between dimensions show no significant differences. Finally, all competencies have a significant relationship and can construct overall GS. These results indicate that there is still a need to strengthen teacher competencies in GS-based learning management and strengthen collaboration with all levels of society.

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1. INTRODUCTION

From the past until now, problems related to the environment have always developed and have no end, considering the very high urgency to be solved. In fact, this problem has become increasingly surprising in the last decade. World Wildlife Fund [1] revealed a 69% decline in the quality of ecosystems on earth. Moreover, from the results of comparative studies in various countries, environmental degradation tends to be more severe in developing countries, including Indonesia [2]–[5]. Of course, this problem is important for humans to solve, considering that the leading theory of anthropocentrism emphasizes that humans are the most determining creatures in the ecosystem order [6]. Building human awareness and skills in preserving ecosystems is very important to build human awareness and skills in preserving ecosystems [7], [8]. Ultimately, all issues regarding environmental sustainability became one of the backgrounds for the publication of the seventeen sustainable development goals (SDGs) initiated by the United Nations (UN) [9].

In order to overcome environmental problems and help achieve SDGs, the concept of education for sustainable development (ESD) has been widely considered and developed [10]. ESD has actually been introduced a long time ago; Gough *et al.* [6] stated that since the early 1980s this concept has become an international discourse. The orientation is to train human sensitivity towards ecosystem sustainability through education. ESD carries out the main mission of developing green education as a sustainable development path through providing green skills (GS) to teachers and students [11]. Although there is no clear history of implementation in educational institutions, Pavlova [10] emphasized that ESD must be embedded in vocational education (VE) institutions. This means that it is very important that VE plays an important role in SD by acquiring and applying green concepts in learning [12]. This is not without reason considering the nature of VE which provides work competencies according to industry needs [13]. Meanwhile, industry is known as one of the largest contributors to waste and ecosystem damage [1], [14]. Therefore, there is no choice but to carefully teach green jobs through green VE for SD [15].

Teaching about green jobs through VE certainly requires efforts that are not easy. In this case, it is very necessary to master GS, both for teachers and students [16]–[18]. GS are the skills needed to reduce environmental impacts and support economic restructuring with the aim of achieving a cleaner, more climate-resilient and efficient economy that preserves the environment and provides decent working conditions. All of them can be classified as generic competencies and specific (task-oriented) competencies required for a specific job. Both types of competencies are used in specific contexts and require knowledge, skills, and attitudes (or beliefs, dispositions, and values) [19].

However, it seems that GS have not been fully mastered by teachers and students. This is evidenced by the lack of awareness of environmental sustainability that VE graduates in some countries have when working [5], [20]. Apart from that, the results of observations in some VE in Indonesia found that there are still many school residents who are indifferent to the rubbish scattered around the school environment. Even when doing practical learning, resource efficiency is very low. These problems are the background to the importance of this research being carried out to analyze the extent to which the level of GS is mastered by teachers and students so that the competent authorities can understand and take specific actions to overcome them. This research aims to measure the level of GS in teachers and students at VE. Some of the research questions include:

i) What is the level of maturity of generic GS in teachers and students in VE?
ii) What are the significant differences between dimensions of generic GS in teachers and students?
iii) What is the extent of cognitive, interpersonal, and intrapersonal competencies in constructing generic GS in teachers and students in VE?

2. METHOD

This research focuses on uncovering and describing the level of GS in students by conducting a survey that adopts a design from [21]. In general, the research began by observing phenomena related to symptoms or shadows related to problems in environment-based learning in VE. The existing phenomena were then studied in depth to analyze the relationship between aspects as the cause of problems in VE teachers' and students' GS. The observed phenomenon is identified as a scope that forms the concept of GS in learning. Considering the limitations of researchers to explore further, it was next decided to measure the extent of students' GS to analyze the level of each dimension (cognitive, interpersonal, and intrapersonal). All three are interpreted in the form of levels and comparisons are made between dimensions to clarify the weaknesses or advantages between dimensions that construct GS. The influence of the three dimensions is also measured to test their contribution to GS, thereby also clarifying the possibility of determining priority scales for improving dimensions sequentially based on the resulting correlation coefficients.

2.1. Research participants

The research was conducted at eight VE in Indonesia. VE with Adiwiyata status are places involved in data collection, considering that Adiwiyata is a green school program in Indonesia. The eight VEs were considered based on recommendations from the ministry of environment and forestry in Indonesia. Apart from that, we also limit that all VEs involved are those who have obtained Adiwiyata status for more than five years, in accordance with considerations from [13], that VE nominations in implementing a learning activity can be called effective if they are consistent for at least five years. Then, our first consideration in selecting participants was ensuring their willingness to take part in the process of filling out the questionnaire. This is important as an anticipatory step to avoid irrationality of the resulting data. Furthermore, the second consideration, we adjusted the research context by not involving new teachers or students who had been at school for less than one year, so that participants focused on work experience or studying at school for more than one year. This was done, considering that the context of this research refers to GS which require time to

be built and adapted to the achievement of work competencies in VE. We adopt a voluntary simple random sampling technique [22]. We reached the end with 318 participants divided into: 88 teachers and 230 students.

2.2. Survey questionnaire instruments

The questionnaire to measure the level of GS was prepared based on the development of instruments that had been formulated by previous relevant research. We filtered various research instruments to obtain instrument criteria that fit the characteristics of the research we conducted. Measurements in the questionnaire adopted a four-point Likert scale, with the options very low (VL), low (L), high (H), and very high (VH). The GS instrument in question includes the dimensions of cognitive competence (CC), interpersonal competence (IC) and intrapersonal competence (IaC). The CC dimension refers to the fundamental aspects needed as a basis for constructing green behavior. We compiled thirty-four items by adopting the instrument formulated by Pavlova [23] which is classified into six indicators on the CC dimension. The six indicators include: green awareness, green literacy, willingness to learn sustainable development, needs analysis skills, system and risk analysis, and green innovation skills. Then, the questionnaire to measure IC had a total of 24 items with four indicators adopted from [24]. The four indicators include green problem-solving skills, communication and negotiation skills, management coordination skills, and green marketing skills. Finally, the dimensions of teacher and student IaC are measured with a total of 16 items with three main indicators adopted from Sern *et al.* [25] including green adaptation and transition, green entrepreneurship skills, and green technology skills.

Before being used for data collection, the questionnaire was confirmed again regarding its validity and reliability. We adopted two methods to strengthen the validity index, namely content validity based on expert opinion interpreted with Aiken values and construct validity based on field trials analyzed using confirmatory factor analysis (CFA). The results of this test are shown in Table 1. Apart from that, we also considered the level of rationality of the data based on the criteria for filling out the GS questionnaire. It took a minimum of 18 minutes to answer a total of 74 items in the questionnaire, so data from participants who completed it in less than that time was not included in the analysis. In this case, 47 data did not meet these criteria and were eliminated, so the final data of participants analyzed was 269.

Based on the results of the validity test, in general, strong clarity of validity is obtained, thus meeting the credibility requirements of the questionnaire. First, a content validity test, based on the opinions of four experts, obtained an Aiken (V) value for all indicators greater than 0.800, so it was declared to have a high validity index [26]. The construct test further strengthens the validity expressed by the loading factor (LF) value above 0.700 in testing using Smart-PLS [27]. Then, the reliability test is described through the composite reliability (CR) coefficient, Alpha value, and average variance extracted (AVE). The results obtained for all constructs have high reliability [28]. Table 2 details the level of reliability in this study.

Table 1. Measuring the validity of the questionnaire

Indicator	Expert (rater)				S_1	S_2	S_3	S_4	$\sum s$	n(c-1)	V	Construct	
	I	2	3	4								LF	*p*
CC 1	4	4	4	4	3	3	3	3	12	12	1.000	0.712	0.000
CC 2	3	4	4	4	2	3	3	3	11	12	0.917	0.769	0.000
CC 3	4	4	4	4	3	3	3	3	12	12	1.000	0.718	0.000
CC 4	3	4	3	4	2	3	2	3	10	12	0.833	0.759	0.000
CC 5	4	4	4	4	3	3	3	3	12	12	1.000	0.744	0.000
CC 6	3	4	4	4	2	3	3	3	11	12	0.917	0.813	0.000
IC 1	4	4	4	4	3	3	3	3	12	12	1.000	0.848	0.000
IC 2	4	4	4	4	3	3	3	3	12	12	1.000	0.850	0.000
IC 3	4	4	4	4	3	3	3	3	12	12	1.000	0.882	0.000
IC 4	3	4	3	4	2	3	2	3	10	12	0.833	0.827	0.000
IaC 1	4	4	4	4	3	3	3	3	12	12	1.000	0.937	0.000
IaC 2	4	3	4	3	3	2	3	2	10	12	0.833	0.831	0.000
IaC 3	4	4	4	4	3	3	3	3	12	12	1.000	0.914	0.000
GS 1	3	4	3	4	2	3	2	3	10	12	0.833	0.803	0.000
GS 2	4	4	4	4	3	3	3	3	12	12	1.000	0.893	0.000
GS 3	3	4	4	4	2	3	3	3	11	12	0.917	0.836	0.000

Table 2. Measuring the reliability of the questionnaire

Construct	Mean	Standard deviation	Alpha	CR	AVE
GS*	3.442	0.791	0.852	0.900	0.692
CC	3.524	0.828	0.842	0.905	0.761
IC	3.723	1.059	0.838	0.885	0.607
IaC	3.782	0.906	0.923	0.942	0.766

Note: *=main construct

2.3. Statistical analysis

Before analysis, the data is first filtered based on the criteria explained in the previous point to ensure its level of rationality. We used three different statistical analysis methods to measure the depth of the collected data. First, the data was analyzed descriptively in relation to its central tendency (mean, median, mode, and standard deviation) and followed by categorization of the mean score based on five categories, namely very low, low, average, high and very high, which are detailed in Table 3. Next, we carried out a comparison test to visualize the comparison between dimensions and indicators. Post hoc test using Tukey Test method was adopted to measure the comparison accurately. Descriptive testing and post hoc tests were carried out using SPSS V 23 software. Meanwhile, a correlation test with the help of SmartPLS 3 is used to measure the contribution of each dimension in constructing GS.

Table 3. Green skills level categorization [29]

Interval score	Based on mean	Category
$\boldsymbol{Mi + 1.5\ SDi < M \leq Mi + 3.0\ SDi}$	3.26–4.00	Very high
$\boldsymbol{Mi + 0\ SDi < M \leq Mi + 1.5\ SDi}$	2.51–3.25	High
$\boldsymbol{Mi - 1.5\ SDi < M \leq Mi + 0\ SDi}$	1.76–2.50	Low
$\boldsymbol{Mi - 3.0\ SDi \leq M \leq Mi - 1.5\ SDi}$	1.00–1.75	Very low

3. RESULTS AND DISCUSSION

3.1. Green skills level description

The level of GS in teachers and students describes the extent to which teachers and students have competence in cognitive, interpersonal and intrapersonal dimensions. These three are basic constructions or general constructions of inherent GS and are able to become readiness capital for teachers and students in helping to preserve the environment. In this case, all dimensions of GS are determined by level categories, which refer to the average score (mean) obtained by each indicator and the total score for each dimension. Table 4 presents the level of GS in students and teachers. As presented in Table 3, the IC dimension is the GS dimension with the highest level of attainment. As analyzed, the dimension of IC among students is at the highest level (M=2.594). Meanwhile, the IaC dimension was the dimension with the lowest level of gain (M=2.188). Finally, the CC dimension occupies a low category level (M=2.300). In this dimension, all indicators are in the spotlight because they have a low category. As presented in Table 4, the dimension of teacher IC is the dimension that also obtains the highest level of GS. As analyzed, the dimension of IC in teachers is at the highest level (M=2.917). Meanwhile, the IaC dimension is the dimension with the lowest level with a low category (M=2.242). Lastly, the CC dimension occupies a high category level (M=2.639).

Table 4. Teacher's and student's GS level

Dimension	Indicator	Teachers		Students	
		Average	Category	Average	Category
CC	Green awareness	2.613	High	2.513	High
	Green literacy	2.553	High	2.503	Low
	Willingness to learn sustainable development	2.671	High	2.360	Low
	Needs analysis skills	2.964	High	2.110	Low
	System and risk analysis	2.885	High	2.179	Low
	Green innovation skills	2.149	Low	2.139	Low
	Total CC	2.639	High	2.300	Low
IC	Green problem-solving skills	2.798	Low	2.413	Low
	Communication and negotiation skills	2.972	High	2.678	High
	Management coordination skills	2.991	High	2.692	High
	Green marketing skills	2.908	High	2.661	High
	Total IC	2.917	High	2.594	High
IaC	Adaptation and green transition	2.534	High	2.516	High
	Green entrepreneurship skills	1.698	Very low	1.602	Very low
	Green technology skills	2.493	Low	2.447	Low
	Total IaC	2.242	Low	2.188	Low

These gains can be interpreted from two points of view related to the average of two different categories obtained by teachers and students. Firstly, the overall GS of students were found to be at a low level, even though the research was conducted at Adiwiyata schools. This indicates that environmental education is not yet optimal in its implementation as an effort to equip students with GS [30]. However, IC shows high acceptance among students. This means that IC is the only dimension of GS with a high level in

students. This may not be surprising, considering that with the massive development of technology, today's students, the millennial generation, are seen as being closer to technology for the purpose of searching for information [31]. Thus, it is not surprising that technical skills, including problem-solving, communication and negotiation, coordination and marketing, are quite mastered [32]–[34]. On the other hand, teachers overall have a high level of maturity in GS. This indicates that teachers actually have mature skills but need to develop teaching methods to teach GS effectively to their students [20]. These results also invite us to be critical of these findings, that GS are inversely proportional between teachers and students, meaning that there is a gap in the transfer of green knowledge and skills in the learning process [35], [36]. However, study by Cole [37] stated that the role of teachers as learning managers who are able to encourage students to green their skills is more highlighted. In fact, research by Hamid *et al*. [38] claimed that teachers in developing country have a greater chance of getting self-development opportunities related to GS, which is different from students who rely more on resources from teachers and perhaps from them learning independently if they are able to direct themselves to learn GS.

3.2. Differences in green skills levels between dimensions

Comparisons need to be carried out as an effort to consider tendencies in the priority scale to be directed towards improvement. We ensure that the comparison reference scale ranges from one to four to avoid analysis errors in SPSS. We carried out two tests at once using a significance level of one percent and five percent. As presented in Table 5, the post hoc test using the Dunnet C test method shows that there are no significant differences in all dimensions. This means that all dimensions actually have acceptance that is not much different. These results show that the comparison between competencies shows that there are no significant differences, giving an important signal that all competencies need to be comprehensively improved [10]. Therefore, Hamza *et al*. [39] suggested improving GS through three aspects, namely strengthening collaboration with stakeholders, developing teacher professionalism, and strengthening a solid foundation, especially for students related to environmental awareness. Research by Hamid *et al*. [38] provides firm confirmation that building human resources in education is the most important aspect as an effort to green the economy and industry. In this aspect, GS that are built from awareness are an orientation that must continue to be developed. In addition, several studies [36], [37] revealed that improving GS through education is also influenced by the readiness of school infrastructure.

Table 5. Comparison between dimensions of GS levels

Comparison between dimensions		Teachers			Students		
		Mean diff.	Sig	Dec.	Mean diff.	Sig	Dec.
CC	IC	-0.278	0.133	Same	-0.294	0.125	Same
	IaC	0.397	0.079	Same	0.112	0.218	Same
IC	CC	0.278	0.133	Same	0.294	0.125	Same
	IaC	0.675	0.048	Different	0.406	0.064	Same
IaC	CC	-0.397	0.079	Same	-0.112	0.218	Same
	IC	-0.675	0.048	Same	-0.406	0.064	Same

3.3. Green skills construction is based on dimensions

Although various theories provide confidence that the level of GS in teachers and students cannot be separated from the extent of their cognitive, interpersonal and intrapersonal competencies. However, we do not propose hypotheses that depart from existing theories. We only tested the extent to which these three aspects construct GS in vocational school teachers and students. Our main consideration in analyzing it is to map a priority scale to dimensions to make systematic improvements. We carried out two tests at once using a significance level of 1% and 5%. In this case, each dimension represents data from each indicator, while green fine (GS) represents total data from each dimension. Smart-PLS was used as a tool for data analysis, and it was confirmed that the number of samples had met the criteria. Table 6 and Figure 1 present the results of a detailed analysis of the relationship between GS and GS dimensions. The construction of GS which includes the three specified dimensions was tested significantly. This gives a strong signal that these three are major basic assets for teachers and students in influencing the achievement of GS.

Research from Pavlova [40] confirmed that cognitive, interpersonal and intrapersonal competencies are general green competencies that must be mastered. All three are interconnected and build GS as a whole. This is also agreed with other research which reveals that these three are the foundation for greening vocational schools which are oriented towards helping build a green economy through greening industry [8], [41]. The CC dimension refers to the fundamental aspects needed as a basis for building environmentally friendly behavior. These fundamentals are very necessary, because they relate to things that are participatory and literate in implementing environmentally friendly work processes which are very important to be

implemented by HR in VE [42]. Then, IC in GS is related to problem analysis skills and how to campaign for the green movement to other people or groups. This is very important, because it is hoped that environmentally friendly human resources will also be able to campaign for environmentally friendly movements widely [43]. Finally, IaC is generally implicit in the growth of green entrepreneurship. Environmentally friendly entrepreneurship skills are expected to be at the forefront of building a green economy in the future [44], [45].

Table 6. Path analysis result

Path		Estimated	SE	p	Decision
GS construction	CC→GS	0.368	0.000	0.000**	Significant
	IC→GS	0.300	0.000	0.000**	Significant
	IaC→GS	0.161	0.002	0.000*	Significant
Correlation between variables	CC↔IC	0.768	0.000	0.000**	Significant
	CC↔IaC	0.619	0.005	0.000**	Significant
	IC↔IaC	0.198	0.001	0.004*	Significant

The level of significance *p<0.05; **p<0.01

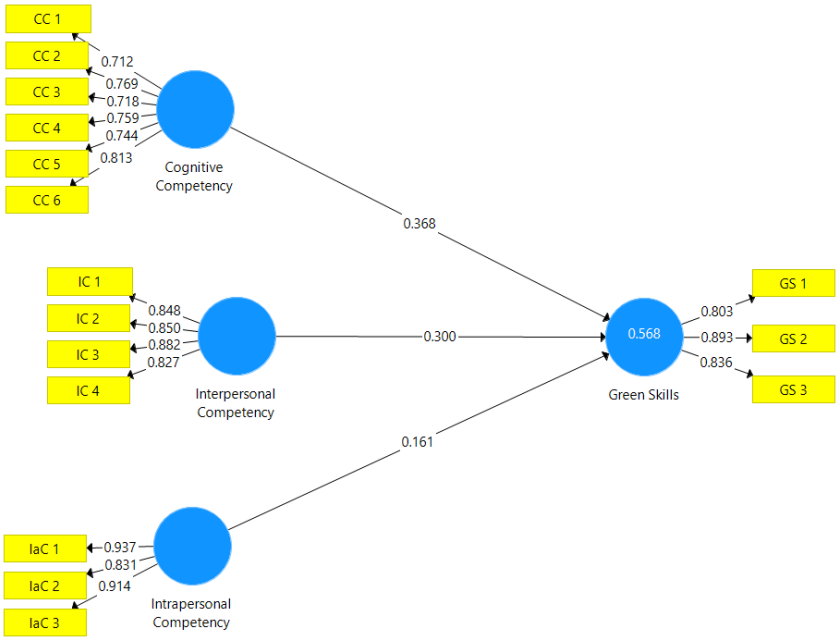

Figure 1. Path analysis

4. CONCLUSION

Even though green skills are being promoted a lot, one of which is through the Adiwiyata school program in Indonesia, the process of learning them still faces significant obstacles in vocational education. This has been proven through analysis of the level of GS in teachers and students, so it still needs to be re-evaluated. The lack of achievement of GS is due to the non-optimal implementation of environmental education as conceptualized in the Adiwiyata program. The most important thing that is still neglected by vocational high schools is that student competency is still low, while teachers are in a high position. This indicates that teachers need reinforcement on how to teach GS effectively to their students. Therefore, it is very important to develop green pedagogy-based teaching competencies optimally. Apart from that, in this case synergy is needed from all levels of society to play a role in building a sustainable green school together.

REFERENCES

[1] World Wildlife Fund, "Environmental damage," *World Wildlife Fund*, 2022. [Online]. Available: https://www.worldwildlife.org/pages/living-planet-report-2022.

[2] M. Demir, H. Rjoub, and M. Yesiltas, "Environmental awareness and guests' intention to visit green hotels: the mediation role of consumption values," *PLoS ONE*, vol. 16, no. 5, p. e0248815, 2021, doi: 10.1371/journal.pone.0248815.

[3] H. Fan, H. M. Ismail, and S. M. Reza, "Technological innovation, infrastructure and industrial growth in Bangladesh: empirical evidence from ardl and granger causality approach," *Asian Economic and Financial Review*, vol. 8, no. 7, pp. 964–985, 2018, doi: 10.18488/journal.aefr.2018.87.964.985.
[4] L. Fu *et al.*, "Environmental awareness and pro-environmental behavior within China's road freight transportation industry: moderating role of perceived policy effectiveness," *Journal of Cleaner Production*, vol. 252, no. 1, p. 119796, Apr. 2020, doi: 10.1016/j.jclepro.2019.119796.
[5] M.-M. Geng and L.-Y. He, "Environmental regulation, environmental awareness and environmental governance satisfaction," *Sustainability*, vol. 13, no. 7, p. 3960, Apr. 2021, doi: 10.3390/su13073960.
[6] A. Gough, J. C.-K. Lee, and E. P. K. Tsang, *Green schools globally: stories of impact on education for sustainable development*. Cham: Springer International Publishing, 2020, doi: 10.1007/978-3-030-46820-0.
[7] Y. Mao, K. Liu, and J. Zhou, "Evolution of green industrial growth between Europe and China based on the energy consumption model," *Sustainability*, vol. 11, no. 24, p. 7168, Dec. 2019, doi: 10.3390/su11247168.
[8] E. Yafi, S. Tehseen, and S. A. Haider, "Impact of green training on environmental performance through mediating role of competencies and motivation," *Sustainability*, vol. 13, no. 10, p. 5624, May 2021, doi: 10.3390/su13105624.
[9] E. S. Kassim, T. A. M. Tajmi, H. Hairuddin, A. M. A. Malik, and S. U. M. Tobi, "Mapping social enterprise to sustainable development goals," *International Journal of Environment and Sustainable Development*, vol. 19, no. 2, pp. 209–237, 2020, doi: 10.1504/IJESD.2020.106674.
[10] M. Pavlova, *Technology and vocational education for sustainable development: empowering individuals for the future*, Dordrecht: Springer Netherlands, 2009, doi: 10.1007/978-1-4020-5279-8.
[11] M. J. A. del Olmo-Fernández, C. Rodríguez-Jiménez, M. J. Santos-Villalba, and G. Gómez-García, "Sustainable development education in the university context: a bibliometric analysis," *Formación universitaria*, vol. 14, no. 3, pp. 85–94, Jun. 2021, doi: 10.4067/S0718-50062021000300085.
[12] C. Jaeger, "Choice for China: what role for vocational education in green growth?" *China & World Economy*, vol. 22, no. 5, pp. 55–75, Sep. 2014, doi: 10.1111/j.1749-124X.2014.12084.x.
[13] S. Billett, *Vocational education: purposes, traditions and prospects*. Dordrecht: Springer Netherlands, 2011, doi: 10.1007/978-94-007-1954-5.
[14] A. A. Olajire, "The brewing industry and environmental challenges," *Journal of Cleaner Production*, vol. 256, no. 1, p. 102817, May 2020, doi: 10.1016/j.jclepro.2012.03.003.
[15] A. Kaliappan and H. Hamid, "Green technology: a must or a need in TVET education in Malaysia?" *Journal of Technical Education and Training*, vol. 13, no. 1, pp. 86–96, 2021, doi: 10.30880/jtet.2021.13.01.009.
[16] S. McGrath and L. Powell, "Skills for sustainable development: transforming vocational education and training beyond 2015," *International Journal of Educational Development*, vol. 50, no. 1, pp. 12–19, Sep. 2016, doi: 10.1016/j.ijedudev.2016.05.006.
[17] N. Kholifah, M. S. Kurdi, M. Nurtanto, F. Mutohhari, M. Fawaid, and T. S. Subramaniam, "The role of teacher self-efficacy on the instructional quality in 21st century: a study on vocational teachers, Indonesia," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 12, no. 2, pp. 998–1006, Jun. 2023, doi: 10.11591/ijere.v12i2.23949.
[18] N. Kholifah, H. Sofyan, Pardjono, P. Sudira, and M. Nurtanto, "Explicating the experience of beginner vocational teachers," *TEM Journal*, vol. 10, no. 2, pp. 719–723, May 2021, doi: 10.18421/TEM102-28.
[19] M. Pavlova and M. Singh, *Recognizing green skills through non-formal learning: a comparative study in Asia*, Singapore: Springer Nature Singapore, 2022, doi: 10.1007/978-981-19-2072-1.
[20] M. N. Handayani, M. Ali, D. Wahyudin, and M. Mukhidin, "Green skills understanding of agricultural vocational school teachers around West Java Indonesia," *Indonesian Journal of Science and Technology*, vol. 5, no. 1, pp. 20–29, Jan. 2020, doi: 10.17509/ijost.v5i1.22897.
[21] L. M. Rea and R. A. Parker, *Designing and conducting survey research: a comprehensive guide*, 4th ed. Hoboken, NJ: John Wiley & Sons, 2014.
[22] J. W. Cresswell, *Research design: qualitative, quantitative, and mixed methods approaches*, 3rd ed. Thousand Oaks, CA: SAGE Publications, Inc, 2009.
[23] M. Pavlova, "Emerging environmental industries: impact on required skills and TVET systems," *International Journal of Training Research*, vol. 17, no. sup1, pp. 144–158, Jul. 2019, doi: 10.1080/14480220.2019.1639276.
[24] A. Yusof, N. A. Atan, J. Harun, M. S. Rosli, and U. M. Abd Majid, "Students engagement and development of generic skills in gamified hybrid service-learning course," *International Journal of Emerging Technologies in Learning (iJET)*, vol. 16, no. 24, pp. 220–243, Dec. 2021, doi: 10.3991/ijet.v16i24.27481.
[25] L. C. Sern, N. Baharom, L. M. Foong, W. M. W. H. Nadrah, R. D. Islamiah, and A. A., "Integrating green skills into TVET curricula in polytechnics Malaysia," *Journal of Technical Education and Training*, vol. 13, no. 3, pp. 15–19, Sep. 2021, doi: 10.30880/jtet.2021.13.03.002.
[26] M. F. Baharuddin, M. N. Masrek, and S. M. Shuhidan, "Content validity of assessment instrument for innovative work behaviour of Malaysian school teachers," *International Journal of Scientific and Technology Research*, vol. 9, no. 4, pp. 1940–1946, 2020.
[27] J. F. Hair Jr, C. M. Ringle, G. T. M. Hult, N. P. Danks, M. Sarstedt, and S. Ray, *Partial least squares structural equation modeling (PLS-SEM) using R*. Cham: Springer Nature Switzerland AG, 2021, doi: 10.1007/978-3-030-80519-7.
[28] C. Fornell and D. F. Larcker, "Evaluating structural equation models with unobservable variables and measurement error," *Journal of Marketing Research*, vol. 18, no. 1, pp. 39–50, Feb. 1981, doi: 10.1177/002224378101800104.
[29] T. Yamane, *Statistics: an introductory analysis*, 2nd ed. New York: Harper and Row, 1967.
[30] B. Li and I. Eilks, "A systematic review of the green and sustainable chemistry education research literature in mainland China," *Sustainable Chemistry and Pharmacy*, vol. 21, p. 100446, Jun. 2021, doi: 10.1016/j.scp.2021.100446.
[31] V. P. Vishnevsky, O. Harkushenko, M. Y. Zanizdra, and S. I. Kniaziev, "Digital and green economy: common grounds and contradictions," *Science and Innovation*, vol. 17, no. 3, pp. 14–27, 2021, doi: 10.15407/scine17.03.014.
[32] M. Astuti, Z. Arifin, M. Nurtanto, F. Mutohhari, and W. Warju, "The maturity levels of the digital technology competence in vocational education," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 11, no. 2, pp. 596–603, Jun. 2022, doi: 10.11591/ijere.v11i2.22258.
[33] M. Astuti, Z. Arifin, F. Mutohhari, and M. Nurtanto, "Competency of digital technology: the maturity levels of teachers and students in vocational education in Indonesia," *Journal of Education Technology*, vol. 5, no. 2, pp. 254–262, Jun. 2021, doi: 10.23887/jet.v5i3.35108.
[34] F. Mutohhari, H. Sofyan, and M. Nurtanto, "Technological competencies: a study on the acceptance of digital technology on vocational teachers in Indonesia," in *Proceedings of the 1st International Conference on Law, Social Science, Economics, and Education, ICLSSEE 2021*, Jakarta: EAI, 2021, pp. 1–11, doi: 10.4108/eai.6-3-2021.2305971.
[35] M. Chen, E. Jeronen, and A. Wang, "What lies behind teaching and learning green chemistry to promote sustainability education?

A literature review," *International Journal of Environmental Research and Public Health*, vol. 17, no. 21. p. 7876, 2020, doi: 10.3390/ijerph17217876.
[36] L. B. Cole and E. M. Hamilton, "Can a green school building teach? A pre-and post-occupancy evaluation of a teaching green school building," *Environment and Behavior*, vol. 52, no. 10, pp. 1047–1078, Dec. 2020, doi: 10.1177/0013916518825283.
[37] L. B. Cole, "The teaching green school building: a framework for linking architecture and environmental education," *Environmental Education Research*, vol. 20, no. 6, pp. 836–857, Nov. 2014, doi: 10.1080/13504622.2013.833586.
[38] M. Z. A. Hamid, Z. Hassan, M. S. Nordin, Y. Kamin, N. A. Atan, and N. Suhairom, "Generic green skills in teaching and learning: meaning and implementation," *Universal Journal of Educational Research*, vol. 7, no. 12A, pp. 121–126, Dec. 2019, doi: 10.13189/ujer.2019.071915.
[39] S. Hamza, A. H. M. Jamal, and Y. Kamin, "Integration factors of green skills into building construction trade programme in Nigeria," *Journal of Technical Education and Training*, vol. 12, no. 1, pp. 1–10, 2020, doi: 10.30880/jtet.2020.12.01.001.
[40] M. Pavlova, "Fostering inclusive, sustainable economic growth and 'green' skills development in learning cities through partnerships," *International Review of Education*, vol. 64, no. 3, pp. 339–354, Jun. 2018, doi: 10.1007/s11159-018-9718-x.
[41] M. Ivanova, S. Ivanov, and I. Petkova, "Green skills gap in the Bulgarian tourism industry," *Sustainability and Climate Change*, vol. 14, no. 4, pp. 238–248, 2021, doi: 10.1089/scc.2021.0016.
[42] M. N. Fitriyanto, Diplan, and A. Pribadi, "Green skills in vocational learning through the project citizen model," in *International Conference on Technology and Vocational Teachers*, 2021, p. 012048, doi: 10.1088/1742-6596/1833/1/012048.
[43] R. Tahir, M. R. Athar, F. Faisal, N. un N. Shahani, and B. Solangi, "Green organizational culture: a review of literature and future research agenda," *Annals of Contemporary Developments in Management & HR*, vol. 1, no. 1, pp. 23–38, May 2019, doi: 10.33166/ACDMHR.2019.01.004.
[44] V. Ramamuruthy, D. Dewitt, and N. Alias, "The need for technical communication for 21st century learning in TVET institutions: perceptions of industry experts," *Journal of Technical Education and Training*, vol. 13, no. 1, pp. 148–158, 2021, doi: 10.30880/jtet.2021.13.01.016.
[45] C. Muangmee, Z. Dacko-Pikiewicz, N. Meekaewkunchorn, N. Kassakorn, and B. Khalid, "Green entrepreneurial orientation and green innovation in small and medium-sized enterprises (SMEs)," *Social Sciences*, vol. 10, no. 4, p. 136, 2021, doi: 10.3390/socsci10040136.

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